VELVET BEANS

S. M. TRACY
Agronomist
and
H. S. COE
Assistant Agronomist, Office of Forage-Crop Investigations

FARMERS' BULLETIN 962
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. July, 1918

Show this bulletin to a neighbor. Additional copies may be obtained free from the Division of Publications, United States Department of Agriculture

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1918

THE VELVET BEAN is the most vigorous-growing annual legume cultivated in the United States.

With the introduction and discovery of early-maturing varieties the area planted to velvet beans in the United States increased from less than 1,000,000 acres in 1915 to more than 5,000,000 acres in 1917.

One or more varieties of velvet beans can be grown successfully in nearly all parts of the cotton belt. The Georgia and Alabama varieties constituted at least 80 per cent of the acreage in 1917.

As velvet beans are very susceptible to cool weather, they should not be planted until the soil has become warm.

This crop is especially adapted to the well-drained portions of the Atlantic and Gulf Coastal Plain areas, and it is in these sections that the greatest acreage is to be found. Velvet beans will make a fair to good growth on the heavy clay soils in the northern portion of the cotton belt provided these soils are fairly fertile.

Velvet beans are usually planted with corn. They may be planted in the same row as the corn or in separate rows. Two rows of corn to one of beans is the most popular method of planting. The yield of corn may be decreased slightly by the beans, but the value of the beans for green-manure and feeding purposes will be much greater than the loss to the corn crop.

The most important use of the velvet bean is as a grazing crop for cattle and hogs in autumn and winter.

The velvet bean is the best annual-legume crop grown in the South for soil improvement.

On account of the extensive, tangled growth of vines it is necessary to pick velvet beans by hand. From 25 to 50 cents per hundred pounds is usually paid for picking the beans.

The usual yield of velvet beans in the pods is from one-half to 1 ton per acre.

Velvet beans make an excellent feed for cattle and hogs. Feeding experiments show that 2 to 2½ pounds of velvet beans in the pod are equal to 1 pound of high-grade cottonseed meal.

VELVET BEANS.

CONTENTS.

VELVET BEANS are one of the most important crops of recent introduction and a determining factor in developing the live-stock industry in the South. As a summer-growing annual legume which produces a large quantity of seed, and because the vines, leaves, and seed are not seriously injured by exposure in the field during winter, the crop is of great value for grazing from late fall until early spring. The beans have a feeding value fully equal to that of wheat bran and nearly equal to that of cotton-seed meal, and so are of special importance in feeding dairy cows. Silage made by mixing the velvet bean with corn is a much better balanced ration than silage made from corn alone. For a fertilizing crop the velvet bean is of greater value than the cowpea, as it makes a much heavier growth and is less expensive.

The velvet bean first came into notice as a forage and fertilizing crop about 1890, at which time its cultivation was confined almost wholly to Florida, but with the introduction and development of earlier ripening varieties its common use has now extended northward to Virginia and Tennessee, the area covered by the crop in 1917 being estimated at more than 5,000,000 acres.

DESCRIPTION.

Velvet beans are the most vigorous-growing annual legumes cultivated in the United States, the vines often reaching a length of more than 50 feet. (Fig. 1.) The leaves are petioled and trifoliate. The membranous leaflets, which are from 3 to 10 inches long and about two-thirds as broad, are shorter than the petiole, the terminal one being rhomboid-ovate and the lateral ones obliquely so. The flowers of the different varieties, which vary in color from white to dark purple, are 1 to 1½ inches in length and are borne in groups of one to three in long pendent racemes.

FIG. 1.—A young plant of the Florida velvet bean.

Velvet beans produce two distinct types of pods, one being covered with a dense, black, velvety pubescence, as in the Florida and Georgia varieties, while in the other type the pubescence consists mostly of short white or grayish hairs, as in the Lyon and Chinese varieties. In all kinds the pods have more or less short bristles which cause a nettlelike irritation of the skin when handled early in the season, but most of this pubescence disappears soon after maturity, leaving the pods smooth and black. The pods of some varieties are only 2 to 3 inches in length, while those of others may reach a length of 5 to 6 inches. The seeds may be nearly spherical or a flattened oval, like the Lima bean, and they vary from nearly white to mottled brown, brown, and black. Varieties which commonly produce mottled seeds may produce occasionally an entirely white or an entirely colored seed.

Velvet beans have no deep taproots, but they produce an abundance of rather fleshy surface roots, which are often 20 to 30 feet in length and abundantly supplied with nodules varying from one-fourth to 1½ inches in diameter. The plants are rarely attacked by root-knot.

HISTORY.

While the Florida velvet bean has been grown for more than 40 years as an ornamental vine for porches and trellises, its value as a soil-improving crop or as a forage crop was not recognized until more recently. As early as 1890 this plant was used to some extent for green manure in citrus orchards in Florida. From that time until the present the acreage has increased rapidly and the crop has served to winter many cattle.

The Florida velvet bean was the only species grown for forage in the United States until about 1906, but during recent years the Department of Agriculture has introduced about 20 other species, including the Chinese, Lyon, and Yokohama varieties, which have become important in certain sections of the country.

According to present information the first early-maturing variety of velvet beans was discovered in August, 1906, on a farm operated by Mr. Clyde Chapman, at Sumner, Ga. At this time several mature plants were found in a field planted to corn and Florida velvet beans. The seed of these plants was collected and planted in corn the following year and plants were produced similar in every respect to those found the previous year. In 1908 seed of this variety was distributed to some of Mr. Chapman's neighbors, but only a small quantity of it was sent out of this immediate section prior to 1912.

An early-maturing variety which so far as known resembled in every respect the one discovered by Mr. Chapman was found in August, 1908, in a field planted to corn and Florida velvet beans on a farm operated by Mr. R. W. Miller, at Broxton, Ga. The early-maturing varieties found by Mr. Chapman and Mr. Miller are known as the "Georgia" or "Hundred-Day Speckled."

Another early-maturing velvet bean was discovered in 1911 by Mr. H. L. Blount, at Flomaton, Ala. This variety, now known as the "Alabama," was found in a field planted to corn and Florida velvet beans. It is a much more vigorous growing and later maturing variety than the Georgia, but it matures considerably earlier than the original variety.

It is very probable that early-maturing velvet beans were also found by other people and that they were present but unobserved in other fields. There seems no doubt that the Georgia, Alabama, and other early-ripening varieties are simply early-ripening kinds of the Florida velvet bean.

VARIETIES.

There are now many varieties of the velvet bean grown in the United States. These differ from each other principally in growth of vine; color of flowers; size, shape, and pubescence of the pods; size, shape, and color of the seeds; and in the length of time required to mature. While these varieties vary greatly in many ways, the common name "velvet bean" is applied to all.

THE FLORIDA VELVET BEAN.

The Florida velvet bean makes a very rank growth of vine and requires a season of eight or nine months without frost to mature. The purple flowers are borne in short clusters, and the pods, which are 2 to 3 inches in length, are nearly straight, blunt at each end, and covered with a black velvety pubescence. (Fig. 2.) The seeds are nearly spherical, about three-eighths of an inch in diameter, and usually grayish mottled with brown. (Fig. 3.) White seeds are produced occasionally, and a white-seeded variety has been isolated, but this variety has shown no special superiority over the one with mottled seeds.

FIG. 2.—Mature pods of the Florida velvet bean. (Natural size.)

THE GEORGIA VELVET BEAN.

The Georgia velvet bean, sometimes called "Early Speckled" or "Hundred-Day Speckled," is a sport of the Florida velvet bean. (Fig. 4.) This variety makes a much less vigorous growth and yields somewhat less seed to the acre than the original Florida variety, but otherwise it is practically the same. As this plant matures in 110 to 130 days, it is adapted to all parts of the cotton belt, and it is one of the best varieties for the extreme northern portion of it.

The plants do not mature in 90 to 100 days, as the name "Ninety-Day Speckled," or "Hundred-Day Speckled," indicates. Numerous tests in many sections of the South and observations of hundreds of fields show that the average date of maturity of this variety is about 120 days. Occasional plants have been noted where the first few pods matured in 90 to 100 days, but this should not be taken as the date of maturity for the crop, as it requires several weeks longer for most of the pods to mature.

FIG. 3.—Seeds of the Florida velvet bean. (Natural size.)

THE ALABAMA VELVET BEAN.

The Alabama velvet bean is very similar to the Georgia variety except that it makes a more vigorous growth and matures about six weeks later. It is very probable that a considerable portion of the

acreage planted in 1917 with seed purchased as the Georgia or Hundred-Day Speckled was seed of this variety, as it is impossible to distinguish between the seeds of the two plants. The Alabama variety is adapted to the country south of central Georgia, central Alabama, and central Mississippi.

FIG. 4.—A well-developed raceme of the Georgia velvet bean. (One-half natural size.)

THE OSCEOLA VELVET BEAN.

The Osceola velvet bean is a hybrid between the Florida and the Lyon varieties developed by Mr. John Belling at the Florida Agricultural Experiment Station at Gainesville. The white or rarely purple flowers of this vigorous-growing plant are borne in rather short racemes. The pods are 4 to 5 inches in length, flat, ridged lengthwise, covered with a black velvety pubescence, and bear from four to six, usually five, seeds. (Fig. 5.) The seeds are slightly larger than those of the Lyon or Yokohama variety and usually are mottled with brown, although occasionally white seeds are produced. (Fig. 6.) The pods are nearly free from stinging hairs. This plant matures in 150 to 160 days and is therefore earlier than the Florida and later than the Georgia and Yokohama sorts. It is adapted to the country south of a line running through the center of the States of Georgia, Alabama, and Mississippi. This midseason-maturing variety is rapidly becoming popular, owing to the fact that it yields heavily.

THE LYON VELVET BEAN.

The Lyon velvet bean was introduced in 1907, the first specimens being obtained from Pampanga Province, Luzon, Philippine Islands. This plant makes a vigorous growth of vine and requires a long season to mature, seldom ripening more than 10 days earlier than the Florida bean. The white flowers are borne on pendent racemes which often reach a length of 2 to 3 feet. The pods are 5 to 6 inches in length, flattened, wrinkled lengthwise, and covered with a grayish pubescence, but becoming nearly smooth when mature. (Fig. 7.) They have a tendency to split open and shatter the seeds when still in the field. The ash-colored seeds are similar in size and shape to seed of the Lima bean. (Fig. 8.)

FIG. 5.—Mature pods of the Osceola velvet bean. (Natural size.)

THE CHINESE VELVET BEAN.

The Chinese velvet bean was introduced from Tehwa, China, in 1909. In most respects this variety is similar to the Lyon, although the vine does not make quite as vigorous a growth and the flower clusters are much shorter. This plant ripens about six weeks earlier than either the Lyon or the Florida variety. For this reason it will mature much farther north. It is recommended by the Louisiana Agricultural Experiment Station for planting in that State. It usually matures before frost south of central Georgia, central Alabama, and central Mississippi.

THE YOKOHAMA VELVET BEAN.

The Yokohama velvet bean was obtained from the Yokohama Nursery Co., Yokohama, Japan, in 1909. This plant produces the smallest vine growth of any of the introduced species and is not a heavy yielder. It is the earliest maturing species thus far introduced, requiring 110 to 120 days to ripen. It should ripen before frost in the Atlantic Coast States south of Washington, D. C. The purple flowers are borne on short racemes. The pods are 4 to 6 inches in length, flat, quite pointed at each end, and covered with a rather long white pubescence. (Fig. 7.) The seeds are ash colored, oblong, flattened, and about two-thirds of an inch in length. (Fig. 9.)

This species has several undesirable characters. Many of the pods form so close to the ground that they become water soaked with each heavy rain, causing many to decay; also the pods split readily and shatter the seed in hot, dry weather.

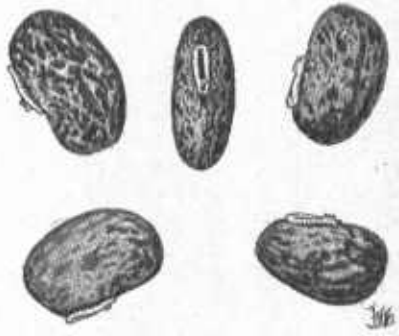

FIG. 6.—Seeds of the Osceola velvet bean. (Natural size.)

THE WHITE HAIRLESS VELVET BEAN.

One of the many hybrids produced by the Office of Forage-Crop Investigations is a cross between the Florida and the Lyon varieties. In 1914, seeds of this hybrid were sent to Mr. H. C. White, of Putney, Ga., who has cultivated the plants since that time. By careful and repeated selection several distinct forms were secured, the most promising of which has been named the "White Hairless." This vigorous-growing plant produces purple flowers and pods that are very smooth at maturity. The seeds are large and white, or occasionally mottled. This variety ripens well in central and southern Georgia.

DISTRIBUTION.

The Florida velvet bean seldom matures more than a few pods to the north of the extreme southern portions of Georgia, Alabama, and Mississippi, but with the introduction or development of early-maturing types the area to which this crop is adapted has been gradually extended northward until it now comprises nearly the entire cotton belt. (See fig. 10.) Most of the varieties, and especially the Georgia and Yokohama, will make considerable growth as far north as the Ohio River, but when the velvet bean is planted north of the southern boundary of Tennessee in the Piedmont section and north of southeastern Virginia in the Coastal Plain area it should be planted primarily as a soil-improving crop, for only in years with

favorable growing seasons and late fall frosts will many pods mature. As the Florida variety has been grown for a long time in the southern portion of the Gulf States as a grazing and green-manure crop, it was only natural that the farmers in sections where it failed to mature fully should be the first to take advantage of newly introduced and

FIG. 7.—Pod of the Lyon velvet bean on the left and of the Yokohama velvet bean on the right. (Natural size.)

early-maturing varieties which promised to give better results. There are other reasons which contributed to the rapidly increased acreage of velvet beans in the Gulf States, the most important of which was the serious damage done by the cotton boll weevil in recent years, making it necessary to change the methods of farming. As corn and velvet beans are well adapted to this section, and as both can be

handled as cash crops, large acreages were planted. The drop in the price of cotton in the winter of 1914–15 also caused a much-increased acreage of velvet beans the following summer, and the favorable results obtained that year were largely responsible for the greatly increased acreage in 1916 and 1917. This plant has been grown at least experimentally in all the sections to which it is adapted, and the successful results obtained the last two years justify the increased acreage which will be planted in 1918.

The acreage of the six States leading in velvet-bean production for 1916 and 1917 is given in Table I.

TABLE I.—*Areas devoted to velvet beans in six Southern States in 1916 and 1917.*[1]

State.	1916	1917	Increase in 1917 over that of 1916.	State.	1916	1917	Increase in 1917 over that of 1916.
	Acres.	*Acres.*	*Per cent.*		*Acres.*	*Acres.*	*Per cent.*
Alabama	1,100,000	2,334,000	112	South Carolina	50,000	188,000	276
Georgia	370,000	1,300,000	251	North Carolina	84,000	138,000	64
Mississippi	302,000	705,000	133				
Florida	450,000	500,000	11	Total	2,356,000	5,165,000	
				Average			119

[1] The figures for 1916 are compiled from those given by the Bureau of Crop Estimates and by State and district agents, and those for 1917 by the Bureau of Crop Estimates.

Previous to 1916 velvet beans were grown mainly in Florida, and the area planted in the entire South in any one year did not exceed 1,000,000 acres.

SUITABLE SOILS.

Velvet beans are especially adapted to the well-drained portions of the Atlantic and Gulf Coastal Plain areas. It is in this section that the greatest acreage is to be found. In this region the velvet bean will make a profitable growth on newly cleared land and also on soil that has been under cultivation for a long time. In many sections it is used extensively on cut-over pineland and on sandy soils as a soil-improving crop, as it has been found that it will produce more vegetable matter under such conditions than any other annual legume grown at the present time.

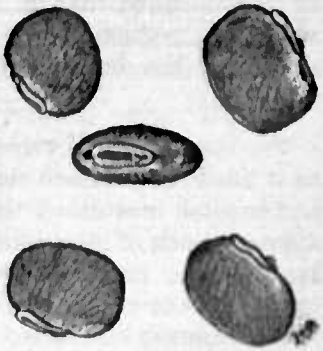

FIG. 8.—Seeds of the Lyon velvet bean. (Natural size.)

Velvet beans make a fair to good growth on the heavy clay soils in the northern portion of the cotton belt provided these soils are fairly fertile, but on poor, compacted soils in this area it is questionable whether they will do better than cowpeas. This crop will not succeed on cold, wet soils and should never be planted before the soil has had time to become warm.

FERTILIZERS.

Even though velvet beans make a fair growth on poor soils, it has been found profitable in some sections to make a small application of fertilizer at the time of seeding, though many farmers do not use fertilizer in planting this crop. Where it is used, the mixture and quantity are the same as are applied to corn.

Velvet beans, through the nodules on their roots, are able to secure nitrogen from the atmosphere, and most of this nitrogen is returned to the land when only the pods are picked or when the crop is pastured and the roots and uneaten portions of the plants decay; therefore, the soil on which velvet beans are grown for a few years will increase considerably in nitrogen content. Phosphorus and potassium, the other two elements which are largely used in commercial fertilizers, must be taken directly from the soil by legumes as by other crops.

Experiments conducted by the Mississippi Agricultural Experiment Station at McNeill show that the yield of the Georgia velvet bean was increased 2.8 bushels per acre by an application of 200 pounds of cottonseed meal, while the results from applications of kainit were negative. No experiments are reported which show the direct effect of acid phosphate, but the Mississippi station recommends 100 to 200 pounds of acid phosphate per acre for velvet beans in the southern part of that State. When this crop is to be planted on poor land it is recommended that an application of acid phosphate be made to at least a portion of the field. The results from this trial should determine the desirability of using acid phosphate in the future.

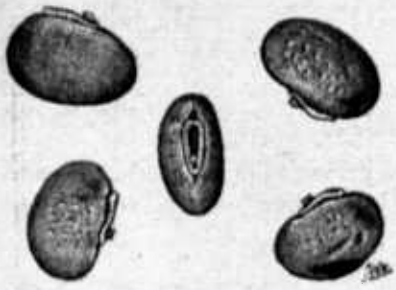

FIG. 9.—Seeds of the Yokohama velvet bean. (Natural size.)

INOCULATION.

The inoculation of velvet beans has been given little consideration, as it has been assumed that the soil throughout the velvet-bean belt has become inoculated through some other agency. As a rule, no apparent lack of inoculation exists when velvet beans are planted on land for the first time, but instances have been noted where the growth of the vines has been materially increased by inoculation.

Experiments conducted by the Office of Soil-Bacteriology Investigations proved that the same strain of organism that inoculates Lima beans, cowpeas, and lespedeza, or Japan clover, also inoculates velvet beans. As lespedeza grows voluntarily over most of the South and as cowpeas have been planted widely for many years in all the velvet-bean region, it is easy to understand why the velvet bean has succeeded so well without artificial inoculation. The large acreage

planted the past three years has served also to inoculate the soil and to increase its inoculating organisms, for the seeds undoubtedly carry some inoculation, and the roots of suitable hosts serve as the best medium for rapidly increasing the inoculating bacteria in the soil. However, when velvet beans are to be planted on soil which has not in recent years grown any of the crops inoculated with this strain of the organism, it is advisable to inoculate the soil or seed.

TIME OF PLANTING.

Velvet beans will not germinate well in cold or wet soil, and the young plants are very susceptible to frost. On this account they should not be planted until all danger of frost is past and a good seed

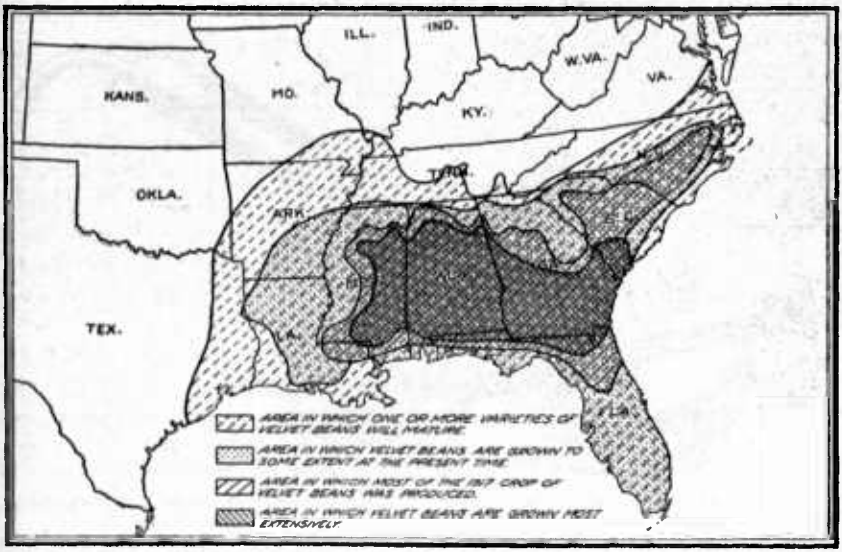

FIG. 10.—Map of the southeastern United States, showing the distribution of velvet beans.

bed can be prepared, or about cotton-planting time. However, when late-maturing varieties are used it is necessary to plant the seed as soon as the soil is in good condition, so that the plants will have as much time as possible for maturing before frost. With early-maturing varieties, such as the Georgia, the date of planting may extend over a period of six weeks or two months in the southern portion of the Gulf States, but even when early varieties are used in the northern part of the cotton belt it is necessary to plant the seed as early as possible, or at corn-planting time. In the Coastal Plain section of the Gulf States, the early planting of early-maturing varieties has been found undesirable by some farmers, as the beans mature so early that the pods of even such varieties as the Georgia will split and shatter the seed to a certain extent, and the foliage will shed before the corn is gathered and the stock are turned into the

field; so, when the crop is to be pastured, many farmers prefer to have the beans frosted before all of the pods are matured rather than to have them mature too early. As most of the beans are grown with corn and as usually it is best to plant corn early, it is better in many cases to grow varieties which can be planted at the same time as the corn and which will mature at the desired time. When this is to be done, the Alabama variety will prove more satisfactory than the Georgia in the southern portion of the cotton belt, for it not only matures five to six weeks later, but it produces a larger vine growth and yields more abundantly.

Growers of velvet beans do not agree as to the best time to plant the beans in the corn. In some sections it is the common practice to plant the corn and beans at the same time, while in other sections

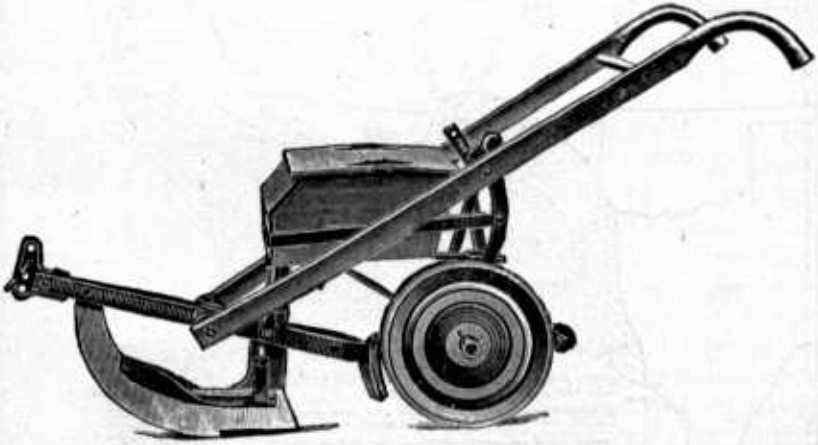

FIG. 11.—Planter used for planting both corn and velvet beans in the same row at the same operation.

the beans are planted some weeks later than the corn. The method of planting the two crops, the variety of beans used, and the labor available should determine this matter. When late-maturing varieties are to be grown, it is necessary to plant them at the same time as the corn, provided the soil is warm and the danger of frost is over; but when early-maturing varieties are used, and especially in the southern portion of the cotton belt, it is best to plant the corn some time before the beans. Where sufficient labor is available, the beans may be planted at a later date by hand in the rows of corn. On the more fertile types of soil the method of planting two rows of corn and one row of beans is used extensively, and when an early variety of velvet bean is used in this way it may be planted later with no extra expense. However, on the poorer soils, where velvet beans should be planted in every row of corn, it is a saving of labor to use a planter which will place both kinds of seeds in the same row and at the same operation. (See fig. 11.) The length of the growing

season for an average year can be approximately determined from the frost lines shown in figure 12, and this, together with the time required for the different types to mature, should give an idea as to the best time of planting.

The length of time required for the ripening of any variety varies greatly with the time of planting. Velvet beans grow well only when the weather is warm, and they make little progress when the soil and air are cold or even moderately cool. The warmer the weather when the seed is planted the more rapid will be the growth of the plants and the shorter the time required to reach maturity.

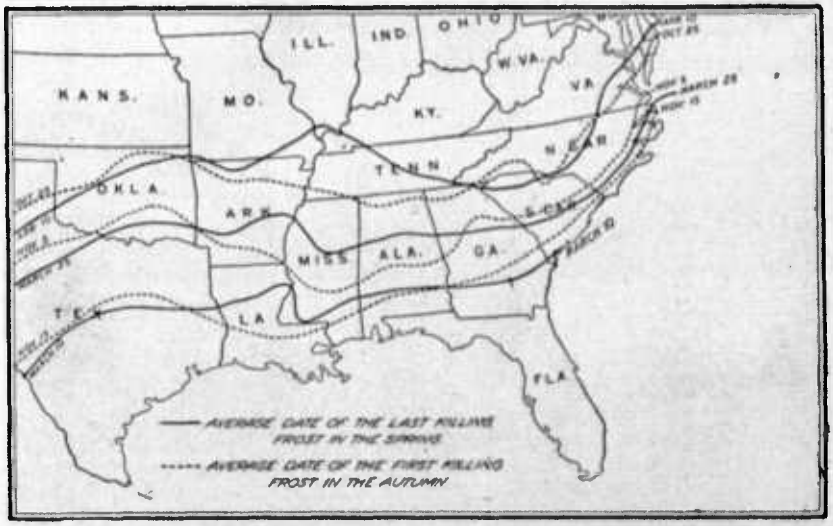

FIG. 12.—Map of the southeastern United States, showing the average dates of the last killing frost in the spring and the first killing frost in the autumn. The three sets of lines represent the approximate northern limit of the late, medium-early, and early maturing varieties of velvet beans.

METHODS OF PLANTING.

Velvet beans should be planted with some supporting crop, and corn answers this purpose very well. (Fig. 13.) In fact, at least 95 per cent of the acreage in 1917 was planted with corn. In 1913 the Florida Agricultural Experiment Station planted the Chinese beans in 4-foot rows without a supporting crop and in alternate rows with sorghum. The average yield of 3 acres planted alone was 23.2 bushels of hulled beans per acre, while the 1 acre planted in alternate rows with sorghum produced 26.9 bushels of hulled seed. In 1916 the Georgia Agricultural Experiment Station conducted similar tests and found that the yield of beans was increased when no supporting crop was used. Pearl millet, Japanese sugar cane, and other strong-growing plants are used also for this purpose, but as corn is an important crop in the area to which the velvet bean is adapted it is used generally.

It is the consensus of opinion that the yield of corn is slightly decreased by the beans, but this will depend largely upon the rate and date of planting the beans and upon the fertility of the soil. When corn is planted several weeks earlier than the beans it is not likely to be damaged, as the vines will not make sufficient growth to pull it down before the ears are nearly mature. However, when late-maturing varieties are planted on fairly fertile soil at the same time as corn, the yield of corn will undoubtedly be decreased, as some of the corn will be pulled down and will probably mold. Even though the yield is decreased the value of the beans for green manure

FIG. 13.—A field of corn and velvet beans in which the beans were planted in every row of corn.

or feeding purposes will be much greater than the loss to the corn crop. The cost of picking the corn is higher when velvet beans are planted with it than when planted alone. The increased cost is estimated by farmers who have had much experience with these crops at 5 cents per bushel. Several methods of planting corn and velvet beans are now in general use, and any one of these will give good results when carefully followed.

When the beans are planted by hand they should be dropped 18 to 24 inches apart in the row on poor soil and about twice that distance apart on fertile soil. This method should be followed when the corn is to be cut for silage or where the soil is poor and the vines will not make a vigorous growth.

The planting of corn and beans in separate rows is rapidly becoming the most popular method, and especially that of planting every third row to beans. (Fig. 14.) When this method is used, the beans may be planted at the same time as the corn or at a later date, as the cultivation of the corn will not interfere with the planting and cultivation of the beans. Even though the beans are planted at the same time as the corn, the corn will have an opportunity to make considerable growth before the bean vines are grown sufficiently to twine about the stalks. In addition to this advantage, the gathering of the corn is

FIG. 14.—Corn and velvet beans planted in separate rows. This method of planting gives the corn an opportunity to become well established before the beans have made sufficient growth to twine around the stalks.

facilitated greatly, and especially so when the Georgia and Yokohama varieties are used, as the vines do not make much growth between the two adjacent rows of corn, where the person who does the gathering may walk without difficulty. However, when the beans are planted in every row or in every other row, the vines are likely to form such a tangled mass that it will be more difficult to gather the corn.

Many farmers who feed hogs extensively plant alternate rows of peanuts and corn, with velvet beans in the corn rows. The entire crop is then pastured. On land where peanuts do well this mixture produces an abundance of feed of a well-balanced ration and will produce a better quality of pork than a feed of either peanuts or velvet beans without the corn.

RATE OF SEEDING.

The rate of seeding will vary with the purpose for which the crop is grown. When beans are planted with corn and it is desired to secure as much corn as possible, the beans should not be planted so closely as to interfere with its growth, and from 2 to 3 quarts per acre will be sufficient; while if a heavy crop of beans is wanted and the corn is not of first importance, twice as much seed should be used. These quantities are for the small-seeded sorts, like the Florida and Georgia, while for the larger seeded sorts, like the Chinese and Osceola, the quantities should be nearly doubled. When planted to make the heaviest possible quantity of vines, either for green manuring or as a smothering crop, from half a bushel to a bushel should be used.

CONTINUOUS CROPPING.

The Florida Agricultural Experiment Station has conducted an experiment to determine the effect upon the yield of velvet beans when grown on the same plat of ground continuously for a number of years. While it is stated that there was no noticeable difference in the growth of the plants from year to year between the continuously planted plat and the check, the yield of seed secured from the continuously planted plat showed a marked decrease. The results obtained are shown in Table II.

TABLE II.—*Effect of continuous planting upon the yield of velvet beans at the Florida Agricultural Experiment Station, 1907 to 1912, inclusive.*

Year.	Yield per acre of shelled beans (bushels).		Year.	Yield per acre of shelled beans (bushels).	
	Continuously planted plat.	Check plat.		Continuously planted plat.	Check plat.
1907	25	21	1911	(1)	(1)
1908	15	23	1912	10	20
1909	11	28			
1910	14	22	Average	15	23

[1] Destroyed by caterpillars.

As will be seen by Table II, the average yield for five years on the continuously planted plat was 8 bushels per acre less than that of the check plat. Experiments at Biloxi, Miss., showed similar results after three successive plantings.

It is much better to plant some nonleguminous crop after velvet beans have been planted for one or two years, and this can be done by adopting a rotation that will include the desired acreage of corn and beans. Where early-maturing varieties are planted in corn and the crop is pastured closely, the yield may not be decreased for several years, but this practice is not as desirable as rotation.

CULTIVATION.

When velvet beans are planted with corn they should receive the same cultivation as the corn until the vines are so long that they will be injured. When beans are sown in rows without a supporting crop, one or two cultivations will serve to loosen the soil, check evaporation, and prevent the growth of weeds until the plants begin to run, after which the ground will be so shaded that no further cultivation will be necessary.

USES OF VELVET BEANS.

The vigorous growth of velvet beans together with their large yield of seed, which may be gathered or allowed to remain in the field without much injury during the autumn and winter, permits this crop to be utilized in a number of different ways. As an annual green-manure crop it is unexcelled. Its value as a feed for stock is now generally recognized in the South, where large quantities are used for this purpose. The use of the beans ground in the pod has increased rapidly the past year, and velvet-bean meal is now taking the place of cottonseed meal in much of the concentrated feed offered for sale. The value of velvet beans as a winter pasture either for carrying cattle through the winter or for fattening them is now well established. With an increase of cattle it is very probable that the use of this crop for winter grazing will replace to a large extent the picking of the beans for grinding, as feeding experiments indicate that but little benefit is derived from grinding the beans for cattle. The crop is utilized also for silage, hay, and as green manure.

HAY.

Velvet beans are seldom used for hay, as the vines become so long and tangled that it is very difficult to handle them. When used for this purpose it is necessary to cut the vines before many of the pods mature, in order to save the leaves, which shatter rapidly from this time until maturity. The hay is rough and coarse at best and is not relished by horses and mules. Yields of 2 to 3 tons per acre may be obtained.

SMOTHERING CROP.

When late-maturing varieties of velvet beans are planted without a supporting crop, they produce such a dense growth of vines that weeds, persistent grasses, and in many cases tree sprouts are smothered out. The Florida Agricultural Experiment Station planted a recently plowed field of strong Bermuda grass to velvet beans in 1898. In 1899 this field was planted to cassava, during which time it remained entirely free of Bermuda grass, and again in 1900, when planted to a cultivated crop, no trace of Bermuda grass was found. When velvet beans are planted as a smothering crop on new land, they should be sown broadcast, but when on old

grassland it is best to plant them in rows, so that at least one cultivation may be given before the vines begin to run. In either case 2 to 4 pecks of seed should be used to the acre.

CORN AND VELVET-BEAN SILAGE.

Velvet beans have been employed to some extent in the making of silage, and for this purpose early-maturing varieties like the Georgia are commonly used. With such a variety most of the vine growth is wrapped about the cornstalks and little trouble is experienced in cutting the corn with corn knives and in running it through the silage cutter. Silage made from this mixture turns black after it has been in the silo for a short time, on account of the juices in the velvet-bean plants, but this apparently does not impair its keeping qualities or feeding value. Stock eat silage made from this mixture as readily as that made from corn alone. Dairymen who have used this mixture speak highly of it and now use it in preference to silage made from corn or sorghum alone.

Table III gives the analysis of a sample of corn and velvet-bean silage as compared with the average of a large number of samples of corn silage.

TABLE III.—*Analysis of corn and velvet-bean silage as compared with silage made from well-matured corn.*

Kind of silage.	Number of analyses.	Constituents (per cent).					
		Water.	Ash.	Crude protein.	Carbohydrates.		Fat.
					Crude fiber.	Nitrogen-free extract.	
Corn and velvet beans[1]	1	73.7	1.0	3.5	5.5	15.6	0.7
Corn (well matured)[2]	121	73.7	1.7	2.1	6.3	15.4	.8

[1] Analyzed by the Bureau of Chemistry, U. S. Department of Agriculture.
[2] Analyses compiled by Henry and Morrison.

GRAZING.

The most important use of the velvet bean is as a grazing crop for cattle and hogs in the autumn and winter. It is not grazed well by horses and mules or by any stock until after it has been well matured or frosted. As the leaves, vines, and pods decay slowly when subjected to weather conditions, velvet beans will furnish feed until early spring. It is usually better to let the crop stand until it is well matured or until it is killed by frost, as the leaves will be off the plants at that time and the corn may be gathered with less difficulty. The beans needed for seed should be gathered before stock is turned into the field. The amount of grazing which will be afforded will, of course, vary with the growth of the crop and the quantity of corn which is not gathered, but it is the custom with many

cattlemen to allow one-third to one-half acre per month for each steer or cow. The usual period for pasturing velvet beans is about three months, but this may be shortened or lengthened as deemed advisable. When the acreage of beans is large and there are not sufficient cattle to stock the pasture at this rate, the grazing is often continued for four or five months, but when this is done there is necessarily some loss of feed through decay. Hogs should be permitted to follow the cattle, as they will consume practically all of the beans which have been broken from the plants and wasted by the cattle. A common practice is to allow one or two hogs in addition to the cattle for each acre of beans.

On the heavier soils of the South there is some danger of packing the land if grazing is continued in rainy weather. On this account pasturing on such soils should be done with more care than on sandy lands.

A good stand of velvet beans should produce about 200 pounds of beef and 100 pounds of pork per acre.

SOIL-IMPROVING CROP.

The velvet bean is one of our best soil-improving crops, both for soils which are naturally infertile and for those which have become somewhat exhausted by long cultivation. The ability of this plant to make a profitable growth on land so poor that most legumes will not thrive places it among the most important crops for the South. In addition to adding at a minimum cost large quantities of vegetable matter to the soil, thus making it more retentive of moisture, the nodules on the roots collect a large amount of nitrogen from the atmosphere. This nitrogen will be left in the soil when the crop is turned under and the plants decay. Even though the crop is grazed, the nitrogen and humus content of the soil will be gradually increased, as much of the nitrogen in the portions of the plants consumed by the stock will be voided.

In many sections velvet beans have proved to be the most profitable crop to plant for one or two years on newly cleared land. In addition to producing sufficient grazing or feed during this time to more than pay the cost of planting and harvesting, the fertility of the land will be so improved that other crops may be grown more successfully. The yield of seed from such ground is usually heavier than from fields which have been long in cultivation.

Many experiments have been conducted to determine the value of velvet beans as a soil-improving crop, but the Florida variety only has been used in these experiments. It is probable that better results were obtained with this species than would have been obtained with the early-maturing varieties, which do not make such a vigorous growth.

It was found at the Alabama, Louisiana, and Florida agricultural experiment stations that the green weight of the vines in an acre of velvet beans was 19,049, 22,919, and 21,132 pounds, respectively. Assuming that the weighings were made as soon as the plants were cut and the moisture content was 82 per cent, these plats produced, respectively, 3,427, 4,125, and 3,804 pounds of dry matter per acre. Moisture-free velvet-bean hay contains approximately 17.6 per cent of crude protein, and on this basis the plat harvested in Alabama contained 96.4 pounds of nitrogen; the Louisiana plat, 116.1 pounds; and the Florida plat, 107 pounds, thus giving an average of 106.5 pounds of nitrogen in the vines for an acre of Florida velvet beans. At the present price of nitrogen in the form of nitrate of soda, the value of the nitrogen alone in an acre of velvet beans yielding at this rate would be $35.

The effect of velvet beans upon the growth of cotton.—In 1898 the Alabama Agricultural Experiment Station planted velvet beans and cotton on poor soil at Auburn. One plat of the velvet beans was cut for hay, yielding 8,240 pounds per acre, while the vines on the other plat were plowed under. In 1899 fertilizer was applied at the rate of 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre, and cotton was planted in 3½-foot drills on April 21. Table IV shows the results obtained.

TABLE IV.—*Effect of a crop of velvet beans on the subsequent yield of seed cotton at the Alabama Agricultural Experiment Station in 1899.*

Crop and treatment in previous year.	Crop in 1899.	Yield per acre (pounds).	
		Seed cotton.	Increase due to velvet beans.
Cotton	Cotton	918	
Velvet beans (cut for hay)	do	1,126	208
Velvet beans (vines plowed under)	do	1,578	660

It will be seen from Table IV that the effect of the velvet beans upon the yield of seed cotton was very marked, and especially so where the entire crop was turned under.

At the Arkansas Agricultural Experiment Station in 1899 an experiment was conducted to determine the comparative value of cowpeas, soy beans, and velvet beans as a fertilizer for cotton. In this experiment the vines of all three plants were plowed under in November and the land bedded and planted to cotton in May. The following yields of seed cotton per acre were obtained:

	Pounds.
Cotton after cowpeas	1,335
Cotton after soy beans	1,488
Cotton after velvet beans	1,550

The results of this experiment show that the value of velvet beans as a green-manure crop is superior to that of cowpeas and soy beans and that the velvet-bean plat produced 215 pounds of seed cotton per acre more than the cowpea plat and 62 pounds per acre more than the soy-bean plat.

The effect of velvet beans upon the yield of corn.—An experiment was conducted by the Alabama Agricultural Experiment Station which shows clearly the beneficial effect of velvet beans upon the growth of corn. In 1900, velvet beans were planted on three plats after oat harvest, and on September 10 one of the plats was cut for hay, yielding 3,632 pounds per acre. The following spring the three velvet-bean plats and a plat which had been in corn the previous year were plowed and planted to corn. Acid phosphate was applied at the rate of 100 pounds per acre to all plats except the one on which the velvet-bean vines had been plowed under. The results obtained are given in Table V.

TABLE V.—*Effect of a crop of velvet beans on the subsequent yield of corn at the Alabama Agricultural Experiment Station in 1901.*

Crop and treatment in previous year.	Crop in 1901.	Acid phosphate applied.	Yield per acre (bushels).	
			Corn.	Increase due to velvet beans.
		Pounds.		
Corn	Corn	100	13.5	.....
Velvet beans (stubble plowed under)	do	100	17.9	4.4
Velvet beans (vines plowed under)	do	100	25.9	12.4
Do	do	.....	21.5	8.0

It will be noted that the plowing under of a velvet-bean crop which had been planted after oat harvest practically doubled the yield of corn the following year. This is an important item, as it does not require the loss of the use of the land for an entire season and the beans may be grown at a minimum cost, since the seeding is inexpensive and disking is sufficient for planting on light soil.

An experiment to determine the effect of peanuts, soy beans, and velvet beans on the yield of corn was conducted by the North Carolina Agricultural Experiment Station at the Tarboro test farm in 1901. All plats received an application of fertilizer at the rate of 131.2 pounds of acid phosphate and 32.6 pounds of kainit per acre. The results obtained are shown in Table VI.

This experiment, as well as the one conducted by the Alabama Agricultural Experiment Station, shows that velvet beans are a most important fertilizing crop for corn.

TABLE VI.—*Effect of a crop of peanuts, soy beans, and velvet beans on the subsequent yield of corn at the Tarboro test farm of the North Carolina Agricultural Experiment Station in 1901.*

Crop and treatment in previous year.	Crop in 1901.	Yield per acre (bushels).	
		Corn.	Increase due to legumes.
Cotton	Corn	20.7	
Peanuts (harvested)	do	21.8	1.1
Soy beans (vines plowed under)	do	24.4	3.7
Velvet beans (vines plowed under)	do	36.5	15.8

The effect of velvet beans upon the yield of oats.—An experiment was performed at the Alabama Agricultural Experiment Station to determine the effect of cowpeas, velvet beans, German millet, and crab-grass on the yield of oats. In May, 1897, two plats were planted with cowpeas, two with velvet beans, and one with German millet, while crab-grass and poverty weed were permitted to grow on a sixth plat. All plats were fertilized at the rate of 264 pounds of acid phosphate and 66 pounds of muriate of potash per acre. The German-millet plat and one plat each of velvet beans and cowpeas were cut for hay. All plats were plowed in September and seeded to oats on October 25, fertilizer being applied to the oats at the rate of 220 pounds of acid phosphate and 44 pounds of muriate of potash per acre. Table VII shows the results obtained.

TABLE VII.—*Effect of different crops, including velvet beans, upon the subsequent yield of oats at the Alabama Agricultural Experiment Station in 1898.*

Crop in 1897.	Yield per acre.		Crop in 1898.	Yield.		Increase over crab-grass plat.
	Grain.	Hay.		Grain.	Straw.	
	Bushels.	*Pounds.*		*Bushels.*	*Pounds.*	*Bushels.*
Crab-grass	(1)	(1)	Oats	7.1	231	
German millet		994	do	9.7	361	2.6
Cowpeas	11		do	28.8	1,463	21.7
Do		2,420	do	34.4	2,013	27.3
Velvet beans		3,872	do	38.7	1,672	31.6
Do	(1)	(1)	do	28.6	1,206	21.5

[1] Plowed under.

It will be noted that the velvet-bean plat from which a crop of hay was removed yielded 10 bushels per acre more than the plat on which the velvet-bean vines were plowed under. These results are directly in contrast to those obtained at the same station with corn on plats treated in the same manner. However, in the experiment with corn the velvet-bean crop was not turned under until the following spring, when the vines either had dried up or had partly decayed. The turning under of a large quantity of green matter usually has a detrimental effect on the yield of the succeeding crop, provided this crop is planted soon after the green-manure crop is

turned under. It is stated that the velvet-bean vines were not properly buried and the seed bed for the oats was not as compact on this plat as it was on the plat where only the velvet-bean stubble was plowed under. This would give the velvet-bean stubble plat considerable advantage in a dry winter like that of 1897–98.

An experiment to determine the effect of plowing under a crop of velvet beans, beggarweeds, cowpeas, and soy beans upon the yield of oats is reported in Bulletin No. 66 of the Arkansas Agricultural Experiment Station. The ground on which this experiment was conducted had been previously in orchard-grass sod. The yield of oats per acre following velvet beans was 53 bushels, as compared with 51 bushels after cowpeas, 49 bushels after beggarweeds, and 48 bushels after soy beans. The check plat, which had been planted to oats the previous year, yielded 36 bushels per acre.

The effect of velvet beans upon the growth of sugar cane.[1]—Adjacent plats on a field of the Scudday plantation of the Leon Godchaux Co., which had been in cane in 1914 and 1915, were planted to velvet beans and corn and peas in 1916. That fall the velvet beans and peas were disked under and the field planted to Ribbon sugar cane. Fertilizer was applied at the rate of 500 pounds of tankage, containing 8½ per cent ammonia and 20 per cent phosphoric acid, on that portion of the field which had been in corn and peas. In 1917 the cane on the velvet-bean plat stooled more and produced thicker and taller stems than that on the other portion of the field, yielding 24 tons per acre, containing 3,324 pounds of sugar, as compared to a yield of 12.7 tons of cane, containing 2,004 pounds of sugar, on the corn and pea land.

Residual effect from velvet beans.—The Alabama Agricultural Experiment Station has conducted several experiments which show the residual effect of turning under both velvet-bean stubble and vines.

In 1898 a plat of velvet beans and a plat of cotton were planted, fertilizer being used at the rate of 240 pounds of acid phosphate and 40 pounds of muriate of potash per acre. Cotton was planted on these plats in 1899 and corn in 1900. The results are shown in Table VIII.

TABLE VIII.—*Residual effect of a crop of velvet beans upon the yield per acre of succeeding crops of cotton and corn at the Alabama Agricultural Experiment Station in 1899 and 1900.*

Crop in 1898.	Crop in 1899.	Yield of seed cotton.	Crop in 1900.	Yield.
		Pounds.		*Bushels.*
Cotton	Cotton	918	Corn	18.0
Velvet beans (vines plowed under)	do	1,578	do	25.5

[1] This experiment was carried out under the supervision of Mr. S. F. Morse, formerly an employee of the United States Department of Agriculture.

In another experiment, sorghum was planted in 1899 on plats which had been in sorghum, cowpeas, and velvet beans in 1898. In 1900 these plats were planted to corn and fertilized at the rate of 240 pounds of acid phosphate and 32 pounds of muriate of potash per acre. The results obtained on these plats for the three years are given in Table IX.

TABLE IX.—*Residual effect of cowpeas and velvet beans on the subsequent yield per acre of sorghum hay and corn at the Alabama Agricultural Experiment Station in 1899 and 1900.*

Crop in 1898.	Crop in 1899.	Yield.	Increase due to legumes.	Crop in 1900.	Yield.	Increase due to legumes.
		Tons.	*Tons.*		*Bushels.*	*Bushels.*
Sorghum (cut for hay)	Sorghum..	3.65	.....	Corn....	24.1	.....
Cowpeas (cut for hay)	...do.....	5.66	2.01	...do....	25.7	1.6
Velvet beans (cut for hay)	...do.....	5.80	2.15	...do....	23.9	(Decrease.)
Cowpeas (seed picked, vines plowed under)	...do.....	5.72	2.07	...do....	27.7	3.6
Velvet beans (vines plowed under)	...do.....	6.76	3.11	...do....	26.8	2.7

It will be seen from Table IX that the increase from the velvet-bean stubble and vines was very marked upon the yield of sorghum, but that their effect upon the yield of corn the second year was very slight; in fact, on the velvet-bean stubble plat the yield of corn was a little less than on the check plat.

In 1898 on reddish loam soil cowpeas, velvet beans, and cotton were planted on adjacent plats which had been fertilized alike with acid phosphate and kainit. The cowpeas and velvet beans were planted thickly in drills and the vines were turned under in March, 1899. Cotton was planted on these plats in 1899, sorghum in 1900, red oats in November, 1900, and sorghum again in July, 1901. A nitrogenous fertilizer was used on the oats, but only acid phosphate and kainit on the other crops. The results obtained with these crops are shown in Table X.

TABLE X.—*Residual effect of cowpeas and velvet beans on the subsequent yield per acre of cotton, sorghum hay, and oats at the Alabama Agricultural Experiment Station in 1899, 1900, and 1901.*

Crop in 1898.	Crop in 1899.	Yield of cotton.	Crop in 1900.	Yield of sorghum.	Crop in 1901.	Yield.	
						Oats.	Sorghum.
		Pounds.		*Tons.*		*Bushels.*	*Tons.*
Cotton	Cotton....	837	Sorghum..	5.1	Oats and sorghum.	23.3	1.0
Cowpeas	...do.....	1,533	...do.....	8.1	.....do.....	26.5	1.5
Velvet beans	...do.....	1,373	...do.....	8.2	.....do.....	37.2	1.6

The results obtained at the Alabama Agricultural Experiment Station show that there is a residual effect for at least two years after a crop of velvet beans has been turned under, and the data in Tables IX and X indicate that the residual effect after the first year is about the same as that obtained from cowpeas.

HARVESTING.

On account of the extensive tangled growth of the vines of velvet beans it is necessary to pick the pods by hand. The cost of picking varies in different sections. Where labor is plentiful an average price of 25 cents per 100 pounds is paid, but in sections where there was a shortage of labor in the fall of 1917 it was necessary to pay as high as 50 cents per 100 pounds in order to obtain pickers.

The price paid for picking also varies with the variety grown, the large-podded, large-seeded sorts being picked much faster because they produce larger and heavier bunches than types like the Georgia. Many laborers prefer to pick the large sorts, as the Chinese and Osceola, in preference to the Georgia and Florida, even when 10 to 15 cents less per 100 pounds is paid. For the average laborer, 500 to 700 pounds of beans in the pod constitute a day's picking. Very seldom is the entire crop gathered, for pickers are often careless and at best miss many pods. On this account stock should be turned into the field after the pickers have finished, in order to consume the vines and the beans not gathered.

Velvet beans should not be gathered until the pods are thoroughly ripe and dry. When immature pods or pods which are damp are picked they will heat and mold when stored in bulk unless thoroughly stirred at frequent intervals. Many mills will not purchase beans that are not dry, and those which do buy them pay much less than they would give for beans in good condition.

Many factors, including the fertility of the soil, cultivation, and weather conditions, influence the yield of seed. It is estimated that the average yield of the total acreage planted in corn in 1917 was about 1,000 pounds of beans in the pod per acre. On fairly fertile soil the early-maturing varieties should produce 1,500 pounds per acre and the late-maturing varieties 2,000 pounds, while 1½ tons per acre is not an unusual yield. The Mississippi Agricultural Experiment Station obtained 4,400 pounds per acre at McNeill, and still heavier yields have been obtained from small areas which have been given special care.

One ton of pods will produce 20 to 22 bushels of shelled beans, the quantity depending on the variety and the amount of moisture in the pods. With varieties like the Georgia and Florida, 90 to 95 pounds of pods will usually thrash out a bushel (60 pounds) of shelled beans, while larger and coarser podded sorts, like the Chinese and Yokohama, require approximately 100 pounds of pods to produce a bushel of shelled beans.

THRASHING.

When velvet beans are to be fed to cattle or ground into meal it is not necessary to hull them; in fact, it is preferable to feed both hulls and beans to cattle, as the hulls have considerable feeding value.

For this reason the quantity of beans thrashed is ordinarily limited to those which are to be used or sold for seeding purposes. The beans may be thrashed with a flail or with one of the several thrashing machines now offered for sale. Regardless of the method of thrashing, only well-matured and thoroughly dried pods can be thrashed without difficulty. If only a few are to be hulled they may be sunned a few hours, put in an ordinary corn sack, and beaten out with a club. When larger quantities are to be thrashed it is better to use one of the machines designed for the purpose. A small machine run by hand which has sufficient capacity to enable a man and a boy to thrash 10 to 15 bushels per day can be purchased for about $25. This machine has been used by gearing it to an automobile, and in that way about 50 bushels were thrashed in a day. A larger machine that requires a 2 to 4 horsepower engine and which will thrash 10 to 15 bushels per hour can be purchased for about $75. Larger machines equipped with cylinders and screens to pick peanuts or shell corn may be successfully used for thrashing velvet beans by making a few changes. Such machines, requiring an 8 to 12 horsepower engine to operate them, will thrash 60 to 70 bushels an hour.

In some sections farmers have bought machines cooperatively or individuals have purchased machines and do community thrashing. Some of the grinding plants also have purchased thrashers and thrash for the public on a cash or toll basis. The price charged for thrashing varies from 15 to 30 cents per bushel of hulled beans.

When the beans are to be sold for seed or for grinding they should be thrashed whenever possible before being placed on the market. When sold in the pod they require so much storage room that the mills are able to care for only a small part of the crop, and of course they deduct the cost of storage and thrashing from the price paid the grower. When thrashed before selling, the pods can be kept for home use, and they have a feeding value equal to or better than that of cottonseed hulls. In the spring of 1917 the price of the thrashed pods was about $15 per ton, or nearly as much as was paid for the unthrashed beans and hulls as gathered from the field.

GRINDING.

Velvet-bean meal is rapidly becoming a standard feed for live stock, and especially as the concentrated part of the many mixed feeds offered for sale on the market. In the manufacture of this meal the hard beans and tough pods are ground or, rather, crushed together by machinery especially designed for handling such material. No standard of fineness for grinding meal has been established, but up to a very recent period most of it was ground so as to pass through sieves having meshes one-fifth to five-eighths of an

inch in size. The trade is now demanding a finer ground meal, and many mills are grinding it as fine as corn meal. This meal is preferred for the manufacture of mixed feeds. It is questionable whether it is necessary to grind the beans and pods when they are to be fed to cattle at home, as practically equal feeding results will be obtained from the use of the unground pods. At most, cracking the beans is all that is required, as they absorb water very quickly when the seed coat is broken. It is impossible to grind velvet beans finely unless they are well matured and thoroughly dry. On this account some mills kiln-dry all beans before grinding. This adds considerably to the cost of manufacture, but it is necessary early in the season in order to prevent the meal from spoiling.

Velvet beans may be ground alone or with other feeds, but when ground alone the meal should be fed in combination with other feeds. A common mixture is to grind velvet beans and corn in the shuck together. In accordance with the use to be made of the feed, velvet-bean meal is used in varying proportions in the manufacture of mixed feed. In horse feeds it seldom forms more than 25 per cent of the entire mixture, while in mixed feeds for dairy cows it may run as high as 70 per cent. A popular mixed feed for dairy purposes is composed of 15 per cent cottonseed meal, 45 per cent corn-and-cob meal, and 40 per cent velvet-bean meal, while a popular horse feed contains in addition to the velvet-bean meal, corn, oats, and ground hay or straw.

In a few sections the entire cornstalks and velvet-bean vines and pods are ground together. It is doubtful whether this procedure is an economical one, because of the low feeding value of the cornstalks. It would be much better to harvest the beans alone or to pasture the entire crop. When the cost of harvesting and grinding are taken into consideration, it is quite evident that the most practical way to utilize this crop is by grazing. The cost of harvesting, hauling to the mill, and the toll for grinding is $9 to $10 per ton. These figures may appear rather high, but when the price of picking is figured at 40 cents per hundred pounds and the grinding at $2 to $4 per ton, it will be seen that the picking and grinding alone of a yield of 1,500 pounds would be $8.25. When the expense of hauling to and from the machine is considered, the total cost of grinding the beans is increased considerably. The price charged for grinding beans on a cash basis varies from $2 to $4 per ton, with an average of $3. When the grinding is done on a toll basis, one-eighth is the usual quantity charged.

Velvet-bean meal is sold for about $15 per ton more than the cost of the unground beans. In the manufacture of this meal there is a loss of 10 to 20 per cent in the weight of the beans from the time of purchase until they are sacked and ready for the market. The loss

is mostly in the drying kilns. The moisture lost in drying will vary considerably, depending on the condition of the beans when dried and the season. A loss of 15 per cent is not uncommon when the beans are dried early in the fall, but later in the season the loss is much less. This loss in weight, together with the expense of drying, grinding, and sacking, makes the meal cost $10 to $12 per ton more than was paid for the beans in the pod.

FEED.

No other crop so high in feeding value can be produced as cheaply or in such quantity on the soils of the South as the velvet bean. In addition to the high feeding value and the low cost of production, this crop, unlike other legumes, may be permitted to remain in the field until late winter without serious injury, as the pods decay very slowly when subjected to weather conditions; in fact, the pods and beans are eaten more readily by live stock after they have softened.

Velvet beans may be pastured with cattle and hogs or the pods may be picked and fed to live stock either whole or after being ground. It is not necessary to grind the pods for home consumption, as practically as good results will be obtained from feeding them whole; but if the pods have been permitted to become dry it is better, although not absolutely necessary, to soak them before feeding. Feeders who have used velvet-bean meal and ground beans [1] find that a larger quantity is needed to secure the same results. It requires about 2½ pounds of velvet-bean meal or 1½ pounds of ground beans to equal in feeding value 1 pound of high-grade cottonseed meal.

As velvet beans are very high in digestible protein, great care should be exercised in feeding them to live stock, especially at first. After the stock become accustomed to the beans they should be kept in the field for only a short period each day until the crop is somewhat reduced, as excessive consumption is a waste of concentrated feed. In addition to wasting concentrated feed, overfeeding sometimes has a laxative effect similar to that caused by feeding too much cottonseed meal. For these reasons and because better gains will be obtained, this crop should be fed in combination with other feeds. This is accomplished when cattle and hogs are pastured on corn and velvet beans, as some corn will be overlooked in picking and the stover contains a relatively high proportion of carbohydrates.

COMPOSITION.

Velvet beans contain high percentages of protein and carbohydrates, thus making them a source of these valuable constituents

[1] Much confusion has been caused by the use of the term "velvet-bean meal" in referring to the products of grinding. In this bulletin "velvet-bean meal" is used to designate the product of grinding the pods and beans together, and when the beans are ground alone they are referred to as "ground beans."

needed for growing stock and milk production. Table XI shows the relative composition of the different varieties of velvet beans and of velvet-bean meal as compared with other feeds.

TABLE XI.—*Composition of different varieties of velvet beans and of velvet-bean meal as compared with other feeds.*

Portion analyzed.	Number of analyses.	Constituents, moisture-free basis (per cent).				
		Ash.	Crude protein.	Carbohydrates.		Fat.
				Fiber.	Nitrogen-free extract.	
Florida velvet bean:[1]						
Shelled beans		3.2	27.7	6.8	55.9	6.4
Pods		6.0	5.9	31.7	55.6	.7
Pods and beans (meal)		3.8	20.1	14.9	56.6	4.6
Chinese velvet bean:[1]						
Shelled beans		3.4	27.7	6.4	57.8	4.7
Pods		5.0	5.5	28.1	60.5	.9
Pods and beans (meal)		4.5	21.0	15.6	56.3	2.6
Kind of feed:						
Velvet-bean meal[2]	5	4.5	20.3	16.5	54.5	4.4
Cottonseed meal (choice)[3]	2,556	6.7	47.7	8.8	27.0	9.8
Corn meal or chop[3]	5,335	1.5	10.5	2.6	81.1	4.3
Wheat bran[3]	7,742	7.0	17.8	10.7	59.6	4.9
Rice polish[3]	1,013	5.3	13.2	2.1	69.2	10.1
Velvet-bean hulls[2]	3	6.0	5.7	30.0	57.0	1.1
Cottonseed hulls[2]	66	2.9	5.1	48.5	41.3	2.1

[1] Analyses made by the Bureau of Chemistry, U. S. Department of Agriculture.
[2] Analyses compiled by the Office of Forage-Crop Investigations.
[3] Analyses taken from Henry and Morrison's "Feeds and Feeding," sixteenth edition.

FEEDING EXPERIMENTS.

Comparatively few experiments have been conducted to determine the value of velvet beans as a feed, but sufficient work has been done to show that live stock will make excellent gains when velvet beans are fed in combination with other feeds. Most of these experiments have been made to determine the relative value of velvet beans as compared with cottonseed meal when fed to steers and milch cows. Hogs relish the shelled beans but will not eat the hulls unless they are finely ground.

Feed for steers.—At the Florida Agricultural Experiment Station velvet beans in the pod were fed in comparison with other feeds to 16 head of steers, averaging approximately 700 pounds, for a period of 84 days. These steers were divided into four lots as nearly equal in weight and quality as possible. Lot 1 received an average daily ration per 1,000 pounds of live weight of 10½ pounds of corn, 3¾ pounds of cottonseed meal, and 13½ pounds of crab-grass hay; lot 2, 6 pounds of corn, 5 pounds of cottonseed meal, 20 pounds of sorghum silage, and 14 pounds of cottonseed hulls; lot 3, 8 pounds of corn, 10 pounds of cottonseed hulls, and 12 pounds of velvet beans in the pods; lot 4, 6½ pounds of cottonseed meal and 25 pounds of cottonseed hulls. The steers which were fed corn, cottonseed hulls, and

velvet beans in the pod made an average daily gain of 2.92 pounds per head at a cost of $7.55 per hundred pounds, while the lot fed corn, cottonseed meal, and crab-grass hay made an average daily gain of 2.58 pounds at a cost of $9.07 per hundred pounds. In computing the cost of gain, the crab-grass hay, velvet beans, and sorghum silage were valued at $4, $6, and $3 per ton, respectively, which was about the actual cost of production. The corn, cottonseed meal, and cottonseed hulls were valued at $1.58, $1.50, and 73 cents per hundred pounds, respectively, the market prices at the time the experiment was conducted. The results obtained in this experiment are given in detail in Table XII.

TABLE XII.—*Results obtained by feeding velvet beans in the pod in comparison with other feeds at the Florida Agricultural Experiment Station.*

Lot.	Ration fed.	Number of steers.	Duration of test.	Average weight (pounds).			Cost per 100 pounds of gain.
				At beginning.	At end.	Daily gain.	
			Days.				
No. 1.	Corn, cottonseed meal, and hay	4	84	730	947	2.58	$9.07
No. 2.	Corn, cottonseed meal and hulls, and silage	4	84	723	946	2.68	10.65
No. 3.	Corn, cottonseed hulls, and velvet beans	4	84	705	950	2.92	7.55
No. 4.	Cottonseed meal and hulls	4	84	717	873	1.85	12.00

At the Alabama Agricultural Experiment Station a test was conducted to determine the relative feeding value of velvet beans in the pods and of cottonseed meal as a concentrate part of a ration for fattening steers. In this experiment 40 steers, averaging 584 pounds, were divided into two lots and fed over a period of 97 days. The ration fed to lot 1 consisted of cottonseed meal and corn silage, while lot 2 received velvet beans in the pods and corn silage. The feed given to each lot was increased or decreased from time to time, the amount varying with the quantity the steers would consume in a few hours after feeding. The cottonseed meal given daily to each steer in lot 1 was gradually increased from 2.76 pounds during the first 28 days to 6.46 pounds for the last 13 days of the experiment. The quantity of corn silage given to each steer in this lot was gradually increased from 35.4 pounds to 43.03 pounds per day. The velvet beans given daily to each steer in lot 2 were increased gradually from 5.7 pounds during the first 28 days of the experiment to 12 pounds for the last 13 days. As the steers consumed more velvet beans they ate less silage. For the first 28 days of the test each steer received an average of 31.07 pounds of silage per day, while during the last 13 days of the experiment each received an average of only 25.6 pounds. The steers which were fed cottonseed meal and corn silage made an average daily gain of 1.6 pounds at a cost of $10.62

per hundred pounds, while those fed velvet beans and corn silage made an average daily gain of 1.5 pounds at a cost of $9.65 per hundred pounds. In computing the cost of the gain cottonseed meal was valued at $45, velvet beans at $20, and corn silage at $4 per ton. The results obtained in this experiment are given in detail in Table XIII.

TABLE XIII.—*Results obtained in a feeding experiment with steers in Alabama, showing the value of velvet beans as compared with cottonseed meal.*

Lot.	Number of steers.	Duration of test.	Average weight (pounds).			Feed for 100 pounds of gain.			
			At beginning.	At end.	Daily gain.	Weight (pounds).			Cost.
						Cottonseed meal.	Velvet beans in the pods.	Corn silage.	
		Days.							
No. 1	20	97	589.00	746.25	1.6	258.18	.....	2,408.58	$10.62
No. 2	20	97	580.25	727.25	1.5	.....	635.12	1,654.75	9.65

It will be seen from Table XIII that 1 pound of cottonseed meal was equal to 2½ pounds of velvet beans in the pods, but that the steers fed velvet beans consumed only two-thirds as much silage as those fed cottonseed meal. The gains made by the steers in each lot were satisfactory, and careful inspection of the two lots on foot and at the packing houses failed to show any appreciable difference either in the finish of the animals or in the carcasses.

Another experiment was conducted by the Alabama Agricultural Experiment Station to compare velvet beans in the pods and corn silage with cottonseed meal and corn silage. For this experiment two lots of 15 steers each were fed on these rations for a period of 119 days. The steers which were fed velvet beans with corn silage made an average daily gain of 1.6 pounds, while those fed cottonseed meal and corn silage made an average daily gain of 1.55 pounds. The results obtained showed that 2.05 pounds of velvet beans in the pods were equal to 1 pound of high-grade cottonseed meal. This experiment is described in detail in Alabama Station Bulletin 198.

Feed for dairy cows.—An experiment was conducted at the Florida Agricultural Experiment Station to show the relative value of velvet beans in the pods and of cottonseed meal when fed in combination with wheat bran and Japanese cane silage to dairy cows. For this experiment six cows were divided into two lots, due consideration being given to the lactation period of each cow. The test was divided into four periods of 16 days each, with a space of five days between the periods, so that the cows could become accustomed to the change in feed. Each cow in lot 1 received a daily ration of 10 pounds of

wheat bran, 4.25 pounds of velvet beans, and 24.5 pounds of silage, while each cow in lot 2 received 10 pounds of wheat bran, 3 pounds of cottonseed meal, and 34 pounds of silage. The feeds were reversed during the second and fourth periods.

The results obtained in this experiment show that 816 pounds of velvet beans in the pods when fed with wheat bran and Japanese cane silage produced 348.7 gallons of milk at a cost of 13.3 cents per gallon, while 576 pounds of cottonseed meal when fed with wheat bran and more silage produced 352.5 gallons of milk at a cost of 16.5 cents per gallon. On this basis velvet beans in the pod are worth $2.37 per 100 pounds when cottonseed meal is worth $2.40 per 100 pounds. The weights of the cows at the beginning and at the end of the test showed that there was but little to choose between the two rations so far as maintenance of animal body and the production of milk were concerned, as all cows made a slight gain in weight.

Another experiment was made at the Florida Agricultural Experiment Station to test the relative value of velvet beans in the pods and cottonseed meal when fed to dairy cows. In this experiment one lot of cows received a daily ration of 4.25 pounds of velvet beans, 10 pounds of wheat bran, and 34 pounds of sorghum silage per head, while those in another lot were each given daily 1½ pounds of cottonseed meal, 10 pounds of wheat bran, and 24½ pounds of sorghum silage. The results of this experiment show that 267.75 pounds of velvet beans in the pods fed with bran and silage produced 934.6 pounds of milk, while 94.5 pounds of cottonseed meal fed with bran and less silage produced 937.1 pounds of milk.

According to Prof. M. P. Jarnagin, the Georgia Agricultural Experiment Station found that 2,035 pounds of velvet-bean meal were equal to 2,000 pounds of cottonseed meal for milk production and that 5½ pounds of velvet beans produced 1 pound of milk as against 5 pounds of cottonseed meal to produce the same quantity.

An experiment was conducted at the Alabama Agricultural Experiment Station to compare a mixture of four parts of corn meal and six parts of velvet-bean meal and corn silage with a mixture of four parts of corn meal and three parts of high-grade cottonseed meal and corn silage. During the 56 days that this experiment was conducted the four cows receiving the mixture containing velvet beans consumed 1,370.9 pounds of velvet beans, 913.9 pounds of corn, and 6,720 pounds of silage, and produced 3,252.4 pounds of milk at a cost of $1.47 per 100 pounds; while the four cows which received the mixture containing cottonseed meal consumed 678 pounds of cottonseed meal, 894 pounds of corn, and 6,700 pounds of silage, and produced 3,418.1 pounds of milk at a cost of $1.33 per 100 pounds. In computing the cost of the milk the cottonseed meal was valued at $40 per ton, the

velvet beans at $22.50 per ton, the corn at $1.18 per bushel, and the silage at $4 per ton.

Feed for pigs.[1]—An experiment to compare the relative value of corn and velvet beans as feed for pigs was conducted by the Florida Agricultural Experiment Station. In this experiment 20 pigs, averaging approximately 63 pounds, were divided into five lots and given the following ration daily for a period of 30 days: Lot 1, 12 pounds of corn; lot 2, 9 pounds of corn and 3 pounds of cracked velvet beans; lot 3, 6 pounds of corn and 6 pounds of cracked velvet beans; lot 4, 6 pounds of corn and 6 pounds of cracked velvet beans plus iron sulphate; lot 5, 9 pounds of corn and 3 pounds of cracked velvet beans plus iron sulphate. The results obtained in this experiment are given in detail in Table XIV.

TABLE XIV.—*Results obtained in a feeding experiment with pigs in Florida, showing the value of cracked velvet beans as compared with corn.*

Lot.	Number of pigs.	Duration of test.	Average weight (pounds).		Average daily gain.	Feed per 100 pounds of gain.[1]		
			At beginning.	At end.		Weight (pounds).		Cost.
						Corn.	Cracked velvet beans.	
		Days.			*Pounds.*			
No. 1	4	30	63.1	76.8	0.46	654.5	.....	$13.09
No. 2	4	30	63.3	82.1	.63	360.0	120.0	8.64
No. 3	4	30	63.9	80.6	.56	268.6	268.6	8.59
No. 4	4	30	63.6	79.3	.52	287.0	287.0	9.18
No. 5	4	30	62.5	78.5	.53	421.8	140.6	10.11

[1] In figuring the cost per 100 pounds of gain the corn was valued at $2 per 100 pounds and the velvet-bean meal at $24 per ton.

It will be seen from Table XIV that the average daily gain of the pigs was increased materially when velvet beans were added to the ration and that the average cost of the feed to make 100 pounds of gain for lots 3 and 4, where equal portions of corn and velvet beans were fed, was $4.21 less than for lot 1, where only corn was fed.

At the Alabama Agricultural Experiment Station a lot of 5 pigs, averaging 62 pounds each, were turned into a field of corn and velvet beans after the corn had been gathered. In addition, the pigs were fed a half ration of a mixture of corn 9 parts and tankage 1 part. Another lot of 5 pigs of similar weight was fed corn meal and tankage in a dry lot. The pigs foraging the velvet beans made an average daily gain per head of 1.23 pounds for a period of 72 days, requiring 0.38 of an acre of beans and 170 pounds of concentrates for 100 pounds of gain. The pigs in the dry lot for the same period made an

[1] Recent data indicate that velvet beans may not be a safe food for brood sows. Cases of abortion as well as of malformation of new-born pigs are reported where sows have pastured freely on velvet beans. Until further information is obtained, it is inadvisable to permit brood sows to eat velvet beans except as a small proportion of the feed.

average daily gain per head of 0.84 pound and consumed 400 pounds of concentrates for 100 pounds of gain. In this experiment an acre of velvet beans grown in corn thus replaced over 600 pounds of concentrates, or, in other words, took the place of 12 bushels of corn.

In another experiment at the Alabama Agricultural Experiment Station two lots of pigs, averaging 72½ pounds each, were fed for a period of 90 days to compare a ration of corn meal alone with one consisting of equal parts of corn meal and finely ground velvet beans. The pigs fed only corn meal made an average daily gain of 0.81 pound at a cost of $8.64 per 100 pounds, while those fed a mixture containing velvet beans made an average daily gain of 0.64 pound at a cost of $9.37 per 100 pounds of gain. In computing the cost of gain, the corn was valued at $1 per bushel and the ground velvet beans at $34 per ton. The fat of the hogs fed the mixture was slightly darker than the fat of those fed entirely on corn. The melting point of the lard from the hogs fed corn only was 1.69° C. higher than that of the lard from the hogs fed partly with velvet beans.

Another interesting experiment was conducted by the Alabama experiment station in 1914 to determine the value of velvet beans as a pasture crop for hogs. In this experiment 15 hogs were divided into three lots. Lot 1 was kept in a dry lot and fed twice daily, while lot 2 and lot 3 had the run of 1 acre each of velvet-bean pasture. The results of this experiment are given in detail in Table XV.

TABLE XV.—*Feeding experiment in Alabama, covering a period of 23 days, to determine the value of velvet beans as a pasture crop for hogs.*

Lot.	Number of pigs.	Ration.	Average weight (pounds).			Feed to make 100 pounds gain.	Total cost to make 100 pounds gain.[1]
			At beginning.	At end.	Daily gain.		
No. 1.	5	Corn, 10 parts; Dried blood, 1 part — Full ration	70	97.6	0.92	316 31.6	$6.59
No. 2.	5	Corn, 10 parts; Dried blood, 1 part — One-half ration Velvet-bean pasture	67.2	95.8	.95	150.07 15.00 .7A	$4.91
No. 3.	5	Corn, 10 parts; Dried blood, 1 part — One-fourth ration Velvet-bean pasture	67.6	89.8	.96	71.03 7.10 .9A	$4.02

[1] The corn was valued at $1 per bushel, the dried blood at $60 per ton, and the velvet-bean pasture at $2.83 per acre, the cost of producing it.

It will be seen from Table XV that the average daily gains were practically the same for the hogs in all three lots, but the cost of producing 100 pounds of pork was much less for the hogs in lot 3 than for those in the other two lots. The velvet beans had been planted with corn, but the corn was gathered before the pigs had been turned in the pasture. Because of a poor stand and early frost the velvet beans were estimated to be only 30 per cent of a total crop.

INSECTS.

The only insect which causes serious injury to the velvet bean is the larva of the velvet-bean caterpillar, which feeds on the leaves. The moth of this caterpillar does not winter in northern or central Florida, but flies northward each summer from the southern end of the peninsula, or perhaps from Cuba. This insect seldom appears farther north than southern Georgia. At times the damage is very severe, and often all of the plants in large fields are entirely defoliated. The moths usually make their first appearance in July in southern Florida, during August in central Florida, and during the last part of August or first part of September in the northern part of that State and in southern Georgia.

As little damage is done for the first 10 days or two weeks after the appearance of the moth, this insect should give no trouble when the early-maturing varieties of velvet beans are planted, as they will usually mature by the middle of September in northern Florida and southern Georgia.

The Florida Agricultural Experiment Station has been successful in combating this pest by dusting the vines with arsenate of lead or zinc arsenite 10 or 12 days after the first appearance of the moth. For this purpose 3 pounds of powdered arsenate of lead or zinc arsenite mixed with 12 pounds of air-slaked lime is sufficient for an acre. When this quantity is used there is no danger from poisoning the stock when pastured in the field, especially after one or two rains.

According to the Bureau of Entomology this insect is generally distributed throughout tropical America and has also been recorded as appearing in Mexico, Costa Rica, Panama, and Cuba.

SOME UNPUBLISHED DATA ON FEEDING VELVET BEANS.[1]

By D. W. MAY, *States Relations Service.*

At the Georgia Experiment Station digestive trials were made recently with steers, testing velvet-bean meal alone and with silage and alfalfa hay as roughage. The results are shown in Table XVI

TABLE XVI.—*Digestion coefficients of velvet-bean meal fed alone and with silage and alfalfa hay.*

Method of feeding.	Dry matter.	Ether extract.	Crude fiber.	Ash.	Nitrogen.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Alone	83.91	76.04	78.95	56.38	75.95	90.62
With silage [1]	77.42	78.51	64.03	65.33	71.11	84.67
With alfalfa hay [1]	79.52	75.48	63.56	67.62	75.17	86.98
With silage and alfalfa hay [1]	74.17	77.63	50.96	44.48	72.25	82.95
Average	78.76	76.92	64.38	58.46	73.62	86.31

[1] In these the digestion coefficients of the velvet-bean meal are determined by difference. The alfalfa and silage digestion coefficients are standards based on feeding-alone experiments.

With dairy cattle at the Tennessee station velvet-bean meal mixed with an equal amount of cottonseed meal in the beginning was taken with a relish. Later it was readily consumed alone as the entire grain ration. In no case, however, was it fed in greater amount than 10 pounds per head per day. In a preliminary test in feeding velvet-bean meal in comparison with cottonseed meal, 9 pounds of the former was hardly equal to 6 pounds of the latter.

From several experiments made by J. M. Scott in feeding velvet beans for milk production at the Florida station, the following results are noted. In the first experiment with velvet beans fed in the pod, milk was produced at 13.3 cents per gallon, as compared with 13.7 cents per gallon when cottonseed meal was fed. In the second experiment, with wheat bran used as a supplementary feed, the cost of producing a gallon of milk on the velvet-bean ration was 12.7 cents, and with a cottonseed-meal ration, 15.6 cents, the latter costing 22.8 per cent more than the former.

At the Tennessee station it was found that, with hogs, velvet-bean meal (pods and beans) could not well make up more than one-third the ration. Fed alone it was unpalatable to them.

[1] This compilation of the feeding value of velvet beans was prepared from unpublished data generously supplied to the Office of Experiment Stations by the experiment stations of Georgia, Tennessee, Florida, and South Carolina upon the request of the Agriculture Committee of the National Research Council.

The South Carolina station reports that pigs on a ration of two-thirds velvet-bean meal and one-third corn meal made a gain during the experiment of 77 pounds, an average of 0.916 pound daily, at a consumption of 4.68 pounds of the ration per pound of gain and a cost of 8.89 cents per pound.

At the South Carolina station a ration of two-thirds velvet-bean meal and one-third corn meal was compared with one of two-thirds soy-bean meal and one-third corn meal for fattening hogs. With the former 4.68 pounds of the feed made 1 pound of gain, while with the latter 7.24 pounds of feed was required per pound of gain. With the velvet-bean meal the animals gained 0.916 pound per day at a cost of 8.89 cents per pound. With the soy-bean meal the average gain per day was 0.548 pound at a cost of 13.97 cents per pound.

○